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An American National Standard

Standard Test Methods for Evaluating Design and Performance Characteristics of Fitness Equipment[1]

This standard is issued under the fixed designation F2571; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

INTRODUCTION

The goal of these tests is to provide reliable and repeatable methods for the evaluation of fitness equipment. The equipment users must recognize, however, that conformance to a standard will not necessarily prevent injuries. Like other physical activities, exercise involving fitness equipment involves the risk of injury, particularly if the equipment is not maintained or used properly.

1. Scope

1.1 These test methods specify procedures and apparatus used for testing and evaluating fitness equipment for compliance to Specification F2276. Both design and operational parameters will be evaluated. Where possible and applicable, accepted test methods from other recognized bodies will be used and referenced.

1.2 It is the intent of this standard to specify test methods for fitness products for use by individuals age 13 and above.

1.3 *Requirements*—Fitness Equipment is to be tested for all of the following parameters:

1.3.1 Stability.
1.3.2 Edge and Corner Sharpness.
1.3.3 Tube Ends and Holes.
1.3.4 Function of Adjustments and Locking Mechanisms.
1.3.5 Handgrip Design and Retention.
1.3.6 Foot Supports.
1.3.7 Load Development and Transmitting Systems.
1.3.8 Chain and Gear Drive Design.
1.3.9 Entrapment Zones and Guarding.
1.3.10 Loading:
1.3.10.1 Intrinsic Loading.
1.3.10.2 Extrinsic Loading.
1.3.10.3 Handlebar Loading.
1.3.10.4 Endurance Loading.
(1) Seat frame endurance loading.
1.3.11 Switch and switch actuation mechanism endurance.
1.3.12 Electrical Guarding.
1.3.13 Maximum Surface Temperature.
1.3.14 Documentation and Warnings Verification.

1.4 The values stated in SI units are to be regarded as the standard. The values in parentheses are for information only.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]
F1749 Specification for Fitness Equipment and Fitness Facility Safety Signage and Labels
F2276 Specification for Fitness Equipment
2.2 *European Standards:*[3]
EN 957-1 Stationary Training Equipment - Part 1: General Safety Requirements and Test Methods
2.3 *UL Standards:*[4]
UL 1439 Standard for Safety Test for Sharpness of Edges on Equipment

[1] These test methods are under the jurisdiction of ASTM Committee F08 on Sports Equipment, Playing Surfaces, and Facilities and are the direct responsibility of Subcommittee F08.30 on Fitness Products.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from European Committee for Standardization (CEN), 36 rue de Stassart, B-1050, Brussels, Belgium, http://www.cenorm.be.

[4] Available from Underwriters Laboratories (UL), 333 Pfingsten Rd., Northbrook, IL 60062-2096, http://www.ul.com.

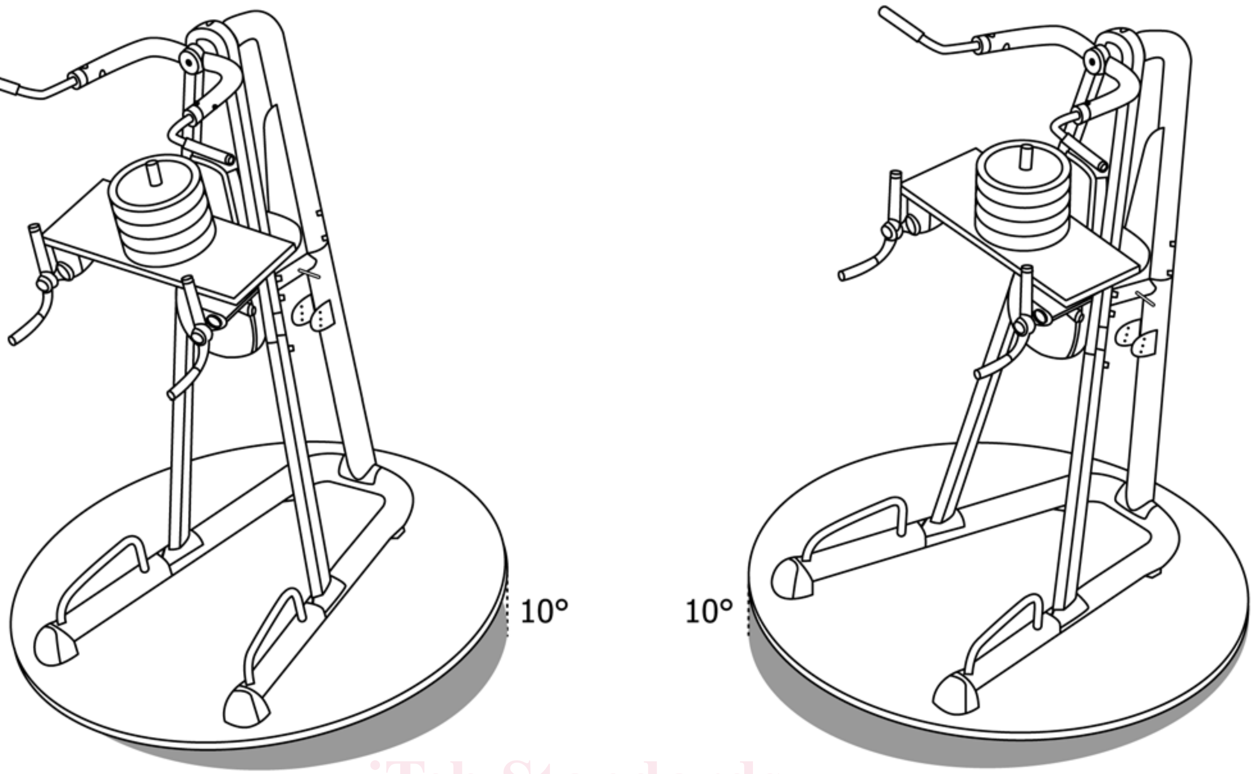

FIG. 1 Tilt Test Illustation Represents Testing the Verticle Knee Raise Station

UL 1647 Motor-Operated Massage and Exercise Machines
UL 60335 Standard for Safety of Household and Similar Electrical Appliances

2.4 *ANSI Standards:*[5]

ANSI B29.1 Precision Power Transmission Roller Chains, Attachments and Sprockets

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *breakage, n*—separation or damage to the structure or components such that they will no longer support the applied load.

3.1.2 *user means, n*—portion of the fitness equipment that the user operates to perform the desired function of the machine. Examples include handles, lifting arms and rollers.

4. Significance and Use

4.1 The purpose of these tests are to provide valid and repeatable methods for the evaluation of fitness equipment assembled and maintained according to the manufacturer's specifications. Use of these test methods in conjunction with Specification F2276 is intended to maximize the reliability of fitness equipment design and reduce the risk of serious injury resulting from design deficiencies.

5. Certification

5.1 These test methods permit self-certification. It is recommended that each manufacturer employ an independent laboratory to evaluate and validate that their designs and test procedures conform and comply to these test methods and Specification F2276.

6. Sample Preparation

6.1 Assemble and adjust the fitness equipment according to the manufacturer's instructions. On machines that are fully assembled, verify according to the manufacturer's instructions that all components are functioning and that they have been adjusted and aligned properly. Unless otherwise stated, the machine must pass the tests without adjustment from this initial condition.

6.2 The individual test methods will describe any variations or modifications that are allowed or are required to the test sample.

7. Test Methods and Procedures

7.1 *Stability:*

7.1.1 Fitness equipment that is designed for the user to maintain balance as part of its function is not required to meet the stability test (that is, a balance board is not tested for stability).

7.1.2 Fitness equipment shall be tested with and without the simulated user load in the orientation that is least stable.

[5] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

7.1.3 *Apparatus and Set-Up*—Refer to Fig. 1. Place sample on a non-skid surface inclined at 10° in the orientation that is least stable. The sample shall rest on the supporting surface without anchoring unless the installation instructions for the machine require that the sample be anchored to the floor. If this is the case, then anchor the specimen per the manufacturer's recommendations. Determine how the user is placed on the machine to perform the exercise (that is, seated, standing, or prone) and then determine how the user's body weight is distributed onto the user support surfaces. For the simulated use test, a method of applying a steady state load equal to the maximum specified users weight or 100 kg (220 lb), whichever is greater, simulating the user's weight and its distribution in the vertical direction at the point(s) of user contact must be provided. As an example, for a seated user, the user support surface shall be adjusted to the uppermost position (if adjustable) and the center of gravity of the load shall be positioned approximatly 300 mm (12 in.) above the user support surface. Possible methods of providing this load include but are not limited to dead weights.

7.1.4 *Calibration*—Using an angle measuring instrument accurate to within 0.1°, verify the non skid surface is 10 ± 0.5°. Calibrate the load measurement apparatus to confirm accuracy to within ±20 N (4.5 lb) at the specified load of the maximum specified user weight or 100 kg (220 lb), whichever is greater.

7.1.5 *Procedure*—Test the sample as follows:

7.1.5.1 If the equipment has a storage position that is different than the use position, place or adjust the machine into that position. With the tilt surface inclined to 10° verify that the sample does not tip over.

7.1.5.2 Reposition the sample into the use position. With the sample machine [no user load applied] positioned on the tilt surface verify that the sample does not tip over with the tilt surface inclined to 10°.

7.1.5.3 Using an appropriate load apparatus such as dead weights, distribute a vertical load equal to the maximum specified user weight or 100 kg (220 lb), whichever is greater (±5 %), in a non-impact manner to the specimen where the user contacts the machine during normal operation. [If only a portion of the user's body is supported by the machine during operation, the simulated user weight shall be decreased by the appropriate amount.] Raise and support any adjustable devices or other user means to simulate the furthest point in the range of travel so that its orientation would cause the least stable condition as encountered during normal operation as shown in Fig. 1. Verify that the sample does not tip over.

7.1.6 *Pass/Fail Criteria*—In none of the above test conditions shall the sample tip over.

7.1.7 *Precision and Bias*—No information is presented about either the precision or bias of the test for measuring stability since the test result is non-quantitative.

7.2 *Edge Sharpness:*

7.2.1 The purpose of this test is to verify that there are no edges in the accessible area that would constitute a risk of injury. Where there is uncertainty, a sharp-edge tester as specified by UL 1439 is to be employed.

7.2.2 *Apparatus and Set-Up*—The sample shall be set up as described in 6.1.

7.2.3 *Calibration*—Calibrate sharp-edge tester per UL 1439.

7.2.4 *Procedure*—Examine the accessible areas by visual and tactile means to ensure all parts are burr-free, rounded or otherwise insufficiently sharp to constitute a risk of injury. Wherever there may be uncertainty as to the sharpness of an edge, use the edge tester and conduct the test per UL 1439.

7.2.5 *Pass/Fail Criteria*—Use the pass fail criteria of UL 1439 to determine if the sample passes this test.

7.2.6 *Precision and Bias*—No information is presented about either the precision or bias of the test for evaluating sharp edges since the test result is non-quantitative.

7.3 *Corner Sharpness:*

7.3.1 This test is a visual inspection of the sample to ensure that all corners in the accessible areas are radiused or chamfered.

7.3.2 *Apparatus and Set-Up*—The sample shall be set up as described in 6.1.

7.3.3 *Calibration*—No calibration required. Visual inspection only.

7.3.4 *Procedure*—Inspect all corners to verify that the corners have been radiused or chamfered.

7.3.5 *Pass/Fail Criteria*—All corners in the accessible area shall be radiused or chamfered.

7.3.6 *Precision and Bias*—No information is presented about either the precision or bias of the test for evaluating corners since the test result is non-quantitative.

7.4 *Tube Ends and Non-Functional Holes:*

7.4.1 This test is a visual inspection of the unit to ensure that all tube ends and non-functional holes in the accessible area are closed off. Holes smaller than 9.5 mm (0.37 in.) are excluded. Seat or other adjustment holes are exempt from this test.

7.4.2 *Apparatus and Set-Up*—The sample shall be set up as described in 6.1.

7.4.3 *Calibration*—No calibration required. Visual inspection only.

7.4.4 *Procedure*—Inspect all tube ends and surfaces in the accessible area to verify that the ends and non-functional holes are closed off by other components, caps, plugs, or covers.

7.4.5 *Pass/Fail Criteria*—All tube ends in the accessible area shall be closed off or the EN 957-1 test probe shall not be able to be inserted.

7.4.6 *Precision and Bias*—No information is presented about either the precision or bias of the test for evaluating tube end closure since the test result is non-quantitative.

7.5 *Adjustment and Locking Mechanism Function:*

7.5.1 This test is a visual and physical inspection of the adjustment or locking mechanisms, or both, used throughout the sample. The purpose is to ensure that the design prevents inadvertent disengagement, and that the adjustment or locking means do not interfere with the user's operation of the machine.

7.5.2 *Apparatus and Set-Up*—The sample shall be set up as described in 6.1. Obtain instructions or a descriptive explanation of the function of the adjustment or locking systems used on the sample from the manufacturer.

7.5.3 *Calibration*—No calibration required. Visual and function inspection only.

7.5.4 *Procedure:*

7.5.4.1 Inspect each adjustment or locking point on the sample machine and ensure that it positively locks into position and that it cannot be disengaged unless the retention system is intentionally deactivated. Examples of positive retention devices include, but are not limited to spring activated pins, clamps or eccentric assemblies. Verify that each adjustment and locking mechanism has a functioning positive retention device.

7.5.4.2 Perform the exercise as described in the operation instructions and note the user's body position relative to the adjustment or locking means. At no point during the user's range of movement shall the adjustment or locking means interfere or limit the movement of the user's body. The locking device shall not be inadvertently disengaged during use. During this observation consider the effects of users of different size or body make up.

7.5.5 *Pass/Fail Criteria*—Retention or locking mechanisms that do not function according to the instructions provided by the manufacturer shall fail the test. Retention or locking mechanisms that interfere, or limit the movement of the user during normal operation of the machine shall fail the test.

7.5.6 *Precision and Bias*—No information is presented about either the precision or bias of the test for evaluating adjustment/locking system design and function since the test result is non-quantitative.

7.6 *Handgrip Design and Retention:*

7.6.1 This test is a visual and physical inspection of the handgrips used on the sample. The purpose is to ensure that the handgrip design maintains the user's grip, remains in position and, in the case of rotating handgrips, is retained against unintended movement during use of the machine.

7.6.2 *Apparatus and Set-Up*—The sample shall be set up as described in 6.1. To facilitate this test a separate handgrip/lifting mechanism replicating the system used on the machine can be set up on a separate test stand. A method of applying to the handgrips a steady state force equal to 90 N (20.2 lb) along the longitudinal direction of the grip shall be used. A method of applying moisture to the grip, such as a spray bottle, shall be provided.

7.6.3 *Calibration*—Calibrate the load measurement apparatus to confirm accuracy to within ±1 N (0.2 lb) at 90 N (20.2 lb). Verify that the resolution of the displacement measuring device is 1 mm (0.04 in.).

7.6.4 *Procedure:*

7.6.4.1 Inspect the sample machine and determine if integral handgrip locations are marked on the machine and that they maintain the grip position when dry. Spray the grip surface with water. Allow the water to remain on the surface and absorb for 5 min. Reconfirm that the grip surface maintains the user's relative grip position by grasping the surface and attempting to slide your hand along the surface. An application of increasing force should be noted before your hand moves.

7.6.4.2 Inspect each non integral handgrip on the sample machine and ensure that it is constructed from a slip resistant material and, if the handgrip is designed to rotate, that it is constrained against unintended movement along its longitudinal axis. Examples of slip resistant materials include, but are not limited to, textured plastic, rubber, foam, or vinyl. Repeat the moisture slip test described above to each grip type.

7.6.4.3 Attach or position the loading means to the handgrip with only enough pressure to ensure attachement to the grip. Scribe or mark the specimen to set a measurement reference point. Apply 90 N (20.2 lb) of force to the loading means for 5 min.

7.6.5 *Pass/Fail Criteria*—Handgrips that move by a dimension exceeding 2 mm (0.08 in.) shall fail the test. Handgrips not constructed from slip resistant materials shall fail the test.

7.6.6 *Precision and Bias*—No information is presented about either the precision or bias of the test for evaluating handgrip design and retention since the test result is non-quantitative.

7.7 *Foot Support Design:*

7.7.1 This test is a visual and physical inspection of the foot support used on the sample. The purpose is to ensure that the foot support reduces slippage.

7.7.2 *Apparatus and Set-Up*—The sample shall be set up as described in 6.1. A method of applying moisture to the foot support surface, such as a spray bottle, shall be provided. The evaluator shall be wearing appropriate exercise footwear when conducting this test.

7.7.3 *Calibration*—No calibration required. Visual and function inspection only.

7.7.4 *Procedure*—Inspect the sample machine and determine if the foot supports on the machine are slip resistant when dry. Spray the foot support surface with water. Allow the water to remain on the surface for 5 min. Rest the evaluator's foot on the support surface. Reconfirm that the surface resists slippage by attempting to slide your foot along the surface. An application of increasing force should be noted before your foot moves.

7.7.5 *Pass/Fail Criteria*—Foot supports that do not resist slippage shall fail the test.

7.7.6 *Precision and Bias*—No information is presented about either the precision or bias of the test for evaluating foot support design since the test result is non-quantitative.

7.8 *Load Development and Transmitting Component Testing:*

7.8.1 This test is a visual, physical, and functional inspection of the cables, belts, ropes, or other means, their end fittings and attachment means used on the sample to route the load from the resistance means to the user means to ensure that the design meets the parameters of Specification F2276.

7.8.2 *Apparatus and Set-Up*—The sample shall be set up as described in 6.1. Obtain instructions or a descriptive explanation of the function of the specimen from the manufacturer. Three load transmitting specimens replicating each component that makes up the system installed on the sample including their attachment means shall be provided for a separate loading test. If the sample cannot be replicated in a shortened representive specimen (as in the case of a linkage bar) then the entire sample shall be tested.

7.8.3 *Calibration*—Calibrate the load measurement apparatus to confirm accuracy to within ±50 N (±10 lb).

7.8.4 *Procedure*—Obtain and record from the manufacturer the maximum load amount that the system is subjected to during operation of the sample machine through its recommended range of motion. This should take into account any multiplying effects designed into the system to increase the resistance to the user. Secure the specimen at its end fittings or attachment points into a tensile loading apparatus capable of loading the specimen with 6× the aforementioned maximum load. The apparatus shall be cabable of recording the maximum load attained during the test. Apply a load to the system equal to 6× the maximum load stated above. Maintain this load for 5 min. If the system fails before attaining the 6× load, record the load attained at failure. If the system attains the load but fails before the 5-min test period has expired record the load and the amount of time at that load. Repeat the test for each of the remaining specimens.

7.8.5 *Pass/Fail Criteria*—If any of the samples fails to attain 6× the maximum load or fails to maintain that load for 5 min then the system shall fail the test.

7.8.6 *Precision and Bias*—No information is presented about either the precision or bias of the test for evaluating belt or rope system design since the test result is non-quantitative.

7.9 *Chain and Gear Drive Design:*

7.9.1 This test is a visual inspection of the unit to ensure that all chain sprockets are guarded or enclosed per ANSI B29.1.

7.9.2 *Apparatus and Set-Up*—The sample shall be set up as described in 6.1. Verify that all guards are properly positioned and secured.

7.9.3 *Calibration*—No calibration required. Visual inspection only.

7.9.4 *Procedure*—Inspect all chain and gear drives and ensure that they are properly guarded per ANSI B29.1.

7.9.5 *Pass/Fail Criteria*—Any portion of the chain or gear drive that fails to meet ANSI B29.1 shall fail this test.

7.9.6 *Precision and Bias*—No information is presented about either the precision or bias of the test for evaluating chain drive design since the test result is non-quantitative.

7.10 *Entrapment Testing:*

7.10.1 This test is to evaluate the risk of injury to the user or to a third party due to inadvertent contact between two or more moving components, or between a moving and a fixed component of the machine. The results of this test determines the adequacy of spacing between components. Methodology entails insertion of the specified probe into the entrapment areas discussed in Specification F2276.

7.10.2 *Apparatus and Set-Up*—The sample shall be set up as described in 6.1 with the pads reinstalled. This test requires probe as specified in EN 957-1, Figure 1 of the 2005 revision . This test also requires sized probes of 9.5 mm (0.37 in.) and 25 mm (0.98 in.) for areas most susceptible to finger injury and 60 mm (2.36 in.) for all other areas. Verify that all guards are properly positioned and secured. An apparatus capable of measuring 4.4 N (1 lb) of pulling force shall be provided.

7.10.3 *Calibration*—Calibrate the load measurement apparatus to confirm accuracy to within ±0.5 N (0.1 lb). Verify that the probe conforms to the dimensions of EN 957-1, Figure 2.

7.10.4 *Procedure*—Refer to Specification F2276 while conducting this test. The evaluator shall place himself/herself on the sample in the operational position and determine and note regions of the sample that are to be evaluated. Areas of concern that are 1800 mm (71 in.) or more above the floor are exempt from this requirement and do not need to be examined further. Areas that are blocked by the user of the equipment throughout the range of motion are also exempt from further examination. The evaluator shall determine, for the area of concern, the portion of the body most likely to be injured and then use the appropriate probe. Insert the probe perpendicular to this area and cycle the machine through one stroke with the minimum resistance selected to verify probe entrapment. Repeat with the full amount of resistance and for the full range of adjustments provided in the machine for its intended use for the area of concern. Pay close attention to the deflection of the machine and its components as this deflection may create new areas of concern. If the probe becomes entrapped, apply a pulling force to remove the probe. Record the force required at the maximum point of entrapment to remove the probe.

7.10.5 *Pass/Fail Criteria*—The probe shall not become entrapped in any mechanical hazard. Entrapment is defined to have occurred if the force to pull out the probe is greater than 4.4 N (1 lb).

7.10.6 *Precision and Bias*—No information is presented about either the precision or bias of the test for evaluating entrapment points because the test result is non-quantitative.

7.11 *Load Testing:*

7.11.1 *Intrinsic Load Testing:*

7.11.1.1 This test is a visual and physical inspection of the specimen to ensure that it shall withstand intrinsic loads applied to the user support surface(s) of the fitness equipment by the user without failure as set forth in Specification F2276.

7.11.1.2 *Apparatus and Set-Up*—The sample shall be set-up as described in 6.1. Note and record whether the specimen is intended for consumer or institutional use. The sample shall not be secured to the floor unless this is required for normal operation of the machine as set forth in the operation instructions provided by the manufacturer. To facilitate this test a separate mechanism replicating the user support sufaces and frame components that are attached to the machine can be set up on a separate test stand.

7.11.1.3 *Calibration*—Calibrate the load measurement apparatus to confirm accuracy to within ±2 % of the maximum load applied.

7.11.1.4 *Procedure*—Determine the location of the load as applied by the maximum specified user weight on the supporting surfaces. Apply the load, as stated in Specification F2276, in the most onerous position of normal use. Distribute this load to the most onerous location of the support and to simulate the actual surface area of normal use (that is, for seats use 300 by 300 mm (11.8 by 11.8 in.), for a foot use 75 by 125 mm (3 by 5 in.)) for a duration of 5 min. Remove the load without disturbing the specimen. Examine the specimen noting the integrity of the user support and the surrounding structures.

7.11.1.5 *Pass/Fail Criteria*—Any user support surface or structure that breaks shall fail this test.

7.11.1.6 *Precision and Bias*—No information is presented about either the precision or bias of the test for intrinsic loading because the test result is non-quantitative.